English version of DE 2015 243

PATENT SPECIFICATION

(11) 1 287 063

DRAWINGS ATTACHED

1 287 063

(21) Application No. 16121/70 (22) Filed 6 April 1970
(31) Convention Application No. A3359 (32) Filed 4 April 1969 in
(33) Austria (OE)
(45) Complete Specification published 31 Aug. 1972
(51) International Classification D04H 18/00 1/48
(52) Index at acceptance
D1R 1D3A 1F2 3B1 3D1A3A 3D1AY 3D3A 3DC3 3D3E 3D3F 3D3X

(54) METHOD OF AND AN APPARATUS OR PERFORATING NONWOVEN FABRICS

(71) We, BUNZL & BIACH AKTIENGESELLSCHAFT, of 161-163 Engerthstrasse, Wien II, Austria, a Joint-Stock Company organised under the laws of Austria, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement: —

This invention relates to a method of and an apparatus for perforating nonwoven fabrics.

There has been no lack of proposals for perforating nonwoven fabrics. Thus, for example, it is known for nonwoven fabrics which have not yet been bonded to be treated with powerful water jets and to produce perforations in the fabric in this manner. For this purpose the fabric is passed between a filter belt and a perforated drum, the water jets being forced through the holes in the drum and producing the desired perforations in the nonwoven fabric as it passes through the latter and then through the filter belt. The fabric treated in this manner can then be dried, impregnated, and strengthened to a greater or lesser extent, while the perforations are mainly retained.

Another known method of perforating nonwoven fabrics works with jets of compressed air. The principle is similar to that described in connection with the abovementioned method, but in this case the support for the fabric is not a filter belt but a belt or drum which is impermeable to air. The air jets passing out of the perforated drum or perforated belt are reflected by the support which is impermeable to air, and thus effect perforation of the fabric. Since during this treatment no moisture is imparted to the fabric, it is in itself possible for the fabric to be subjected to this treatment in a pre-impregnated condition. The fabric may, however, also be impregnated and consolidated only after the perforation treatment by the compressed air jets. The intermediate drying before the final consolidation of the nonwoven fabric is in either case eliminated when the process is conducted in this manner.

All these methods used highly compressed media, while certain sealing problems occur in respect of the moving parts through which the media are forced out. It has now been found that perforating of nonwoven fabrics can also be effected by a mechanical process in which the injection of compressed air or compressed gas plays only a subordinate part and therefore the sealing problems referred to occur only to a subordinate extent. Furthermore, the method and apparatus of the invention enable the perforation of nonwoven fabrics to be effected with a higher working speed than was customary hitherto.

Accordingly, the present invention consists in a method of perforating nonwoven fabrics, wherein needle-like devices, whose cross-section increases continuously from the tip to the base without change of shape, the shape being that desired for the perforations, pierce the nonwoven fabric from one side at the points where perforations are desired, a current of gas being blown in the opposite direction from the other side along the surface of the needle-like devices. By virtue of blowing a current of gas in the opposite direction to that of the entry of the needle-like device along the surface thereof, the penetration of this device, which hereinafter will be referred to as a needle does not carry fleece fibres with it and tear them out of the web of nonwoven fabric. Particularly in the case of more compact fabrics there would otherwise be a danger that the penetrating needles would not pass through the fabric but would merely deform it, so that a perforated nonwoven fabric would not be obtained but only a deformed nonwoven fabric, which does not possess perforations, but only raised parts or depressions at the desired needle penetration points.

The impregnation of the nonwoven fabric

SEE ERRATA SLIP ATTACHED

for the purpose of strengthening it may be carried out before or after the perforation by the method of the invention. It is generally preferred to effect the impregnation after the perforation, since by this means the soiling of the perforating device is avoided. In some cases it may be advantageous to moisten the nonwoven fabric before the perforation and optionally also to heat the perforating device which subjects the nonwoven fabric to a certain pressure; a certain ironing effect can be achieved in this manner, which would ensure that the perforations formed in the fabric will reliably be fully retained during the subsequent mechanical treatment. This is also an advantage which could not be achieved by previously known perforation methods.

The present invention also provides apparatus for carrying out the method described above, which comprises two surfaces adapted to move in synchronism with one another, for example the surfaces of two rollers or of one roller and a belt, a plurality of conical or pyramidal needle-like devices provided on one of said two surfaces and adapted to come into engagement with corresponding perforations on the opposite surface, the perforations being larger in area than the cross-section of the respective needles engaging in them, and under the perforated surface there being provided a device for injecting a current of gas into the annular gap between the penetrating or penetrated needle and the corresponding perforation.

Two rollers are advantageously provided in the apparatus, one roller being provided with the needles and the other with the perforations, the roller provided with the perforations being hollow and its interior being in communication with a gas supply device, for example an air pump; in this embodiment the interior of the roller is sealed, over the portion of the periphery not in engagement with the needles in the roller lying opposite it, by a sealing metal sheet disposed inside or outside the roller, so as to prevent the escape of the gas introduced. It is however also possible for a wide nozzle to be provided inside the perforated hollow roller or beneath a perforated belt, this nozzle covering the surface inside which the needles penetrate into the perforated support and in turn lying against the inner wall of the perforated roller or drum or against the bottom surface of the perforated belt, and thus to a large extent preventing the escape of air or gas at points where this is not desired. Since in the present case relatively low pressures are used, there are no sealing problems.

In order that the invention may be more readily understood, reference is made to the accompanying drawings which illustrate diagrammatically and by way of example, several embodiments thereof, and in which:

Figure 1 illustrates an apparatus according to the invention, in which for the sake of simplicity only the case of a needle which has penetrated through the non-woven fabric is illustrated;

Figure 2 is a section of another embodiment of the apparatus according to the invention; and

Figures 3*a*, 3*b* and 3*c* show various forms of needles.

Referring to the drawings, Figure 1 shows a roller 1 having a needle 2, beneath which a perforated belt 3 is disposed, one perforation 4 being shown. A non-woven fabric 5 runs between the roller 1 and the perforated belt 3. A nozzle 6 having an air supply means 7, is disposed under the perforated belt 3. When air is injected through the air supply means 7, this air moves through an annular gap 9, formed between the needle 2 and the perforation 4, in the upward direction as indicated by the arrows 8, and blows out of the annular gap 9 any fibres of fleece which may have been carried along by the needle 2. The needle 2 thus effects clean perforation of the nonwoven fabric 5.

In Figure 2 there is also shown a roller 1 with needles 2, but in this case the needles 2 engage in perforations 4 in a perforated roller 3*a*. The nonwoven fabric 5 is moved towards and away from the perforating device by means of conveyor belts 10. In the interior of the perforated roller 3*a* there is provided a partial cover 11 which has the effect that the air introduced through a pipe 7*a* can escape from the interior of the roller only through the perforations which are precisely in engagement with a needle 2. In this embodiment the interior of the needle roller 1 is likewise hollow and is in communication with a supply means 12 for a heating medium by means of which the needle roller 1 can be heated. Moreover, it is possible for hot air to be blown, for example through the pipe 7*a*, so that the interior of the perforated roller 3*a* and thus the entire roller is heated, thereby ironing the fabric.

The needles 2 themselves may have practically any desired cross-sectional shape, provided that they taper continuously in the upward direction. Examples of such shapes are shown in Figures 3*a*, 3*b* and 3*c*.

It is advantageous for the length of the needles to be such as to amount to from 1 to 2 times the thickness of the nonwoven fabric treated. The ratio of needle length to maximum needle diameter advantageously amounts to 3:1.

WHAT WE CLAIM IS:—

1. A method of perforating nonwoven fabrics, wherein needle-like devices, whose cross-section increases continuously from the tip to the base without change of shape, the shape being that desired for the perfora-

tions, pierce the nonwoven fabric from one side at the points where perforations are desired, a current of gas being blown in the opposite direction from the other side along the surface of the needle-like devices.

2. A method of perforating nonwoven fabrics, substantially as herein described.

3. An apparatus for carrying out the method claimed in claim 1 or 2, comprising two surfaces adapted to move in synchronism with one another, for example the surfaces of two rollers or of one roller and a belt, a plurality of conical or pyramidal needle-like devices provided on one of said two surfaces and adapted to come into engagement with corresponding perforations on the opposite surface, the perforations being larger in area than the cross-section of the respective needles engaging in them, and under the perforated surface there being provided a device for injecting a current of gas into the annular gap between the penetrating or penetrated needle and the corresponding perforation.

4. An apparatus as claimed in claim 3, wherein both surfaces are rollers and the roller carrying the perforated surface is a hollow roller the interior of which is in communication with a gas supply, for example an air pump, while the portion of the periphery of the roller which is not in engagement with the needles is sealed against the escape of the gas introduced by means of a seal disposed inside or outside the roller.

5. An apparatus as claimed in claim 3, wherein inside the perforated hollow roller or beneath a perforated belt there is provided a wide nozzle covering the surface within which the needles penetrate into the perforated support and in turn lying against the inner wall of the perforated roller or against the lower surface of the perforated belt so as to form a seal.

6. An apparatus as claimed in any one of claims 3 to 5, wherein the ratio of needle length to maximum needle equivalent diameter amounts to 3:1, the maximum needle equivalent diameter being the diameter of the smallest circle which encloses the maximum needle cross-section.

7. An appparatus for perforating nonwoven fabrics substantially as hereinbefore described and with reference to the accompanying drawings.

8. A non-woven fabric perforated in accordance with the method and on an apparatus claimed in any one of the preceding claims.

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Printed for Her Majesty's Stationery Office by Burgess & Son (Abingdon), Ltd.—1972.
Published at The Patent Office, 25 Southampton Buildings, London, WC2A 1AY,
from which copies may be obtained.

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Fig.1

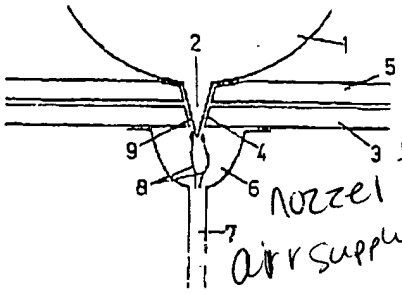
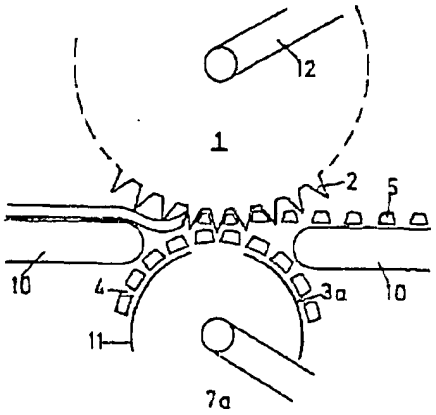


Fig.2



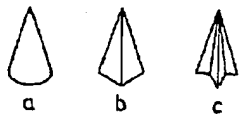


Fig.3